



ADVANCED MATERIAL STUDIES

-RICHARD PITTON - JESSICA ARRAJ -

NANO TECHNOLOGY

Nano technology, one of the more significant advances of the modern era, has already instigated its influence everyday life. In an age where energy use has been placed under heavy scrutiny, nano technology has initiated the development of functional materials and surfaces with huge innovation prospective.

Some of the most common nano materials comprise of polymer emulsions, aerogels and zeolites, carbon black, dendrimers, nanosilica and metallic nanoparticles, titanium dioxide, cerioxide and aluminium oxide. The nano particles which form nano materials are minor in proportion. The particles are usually merged with their related materials using various conventional methods such as dipping or spraying techniques.

Nano-architecture will allow for designs that better interact with the human senses. Experiencing this type of architecture could feel more "natural" and less forced than many of the designs we experience today.

DESIGNING YOUR OWN MATERIALS

Through merging architecture and nanotechnology, the ability to design your own materials will provide architects with new freedoms such as going further than wood, concrete and glass.

BUILDINGS THAT WILL "GROW"

Architecture would then be more of a dynamic entity, morphing to occupant needs and creating a growing environment which evolves according to various respective codes.

RESPONSIVE ARCHITECTURE

Nanoarchitectural spaces will become more personalised and will be a likely benefit, giving occupants better flexibility and choice as design variations are able to meet their needs.

BRINGING ARCHITECTURE CLOSER TO NATURE

Having the building's architectural design more synchronised and complimentary with nature will become more likely with nano-architecture.

The following information will provide a description of the functionality of nano materials.

AIR PURIFYING

In a worldwide predicament, healthy air is quickly becoming a scarce resource with increased global pollution levels. Nano materials have made it possible to improve the quality of air by equipping various products with antibacterial properties. The nano materials have the capability to eliminate unpleasant odours and pollutants. The air purifying properties of nano materials purify air both indoors and outdoors.

Indoors

Industrialised nations, more so than any other, find indoor air quality particularly significant as a vast amount of people spend a large amount of their time indoors. For an indoor space to truly feel comfortable it requires a pleasant scent rather than a solitary beautiful design.

Nano technology makes it possible to chemically decompose odours into their inoffensive basic quantities. The molecules are cracked, giving off steam and carbon dioxide. This approach is used to offset the sick building syndrome (SBS). This principle is also used for pollutants such as nicotine. The molecules in the nicotine pollutant are cracked and filtered out of the indoor air. Pollutants are not only pre-existent in a building, they can also be introduced in the form of formaldehyde during the installation of new parts. Thus, the ability to improve air quality is significant for new and pre-existing buildings. Ammonia benzene and fish odours, amongst other materials, can also be filtered out with the use of nano materials.

However, oxygen content and relative humidity also contribute to overall air quality. Such factors cannot be modified with nano technology and proper ventilation should be in place.

Outdoors

In the modern era, environmental pollution has become a publicly discussed topic around the globe. More and more companies are committing themselves to sustainable construction, such an example is the use of photo catalytic concrete which has a high air purifying capacity, thus reducing existent pollutants. Although in the interim such products remain highly costly, building facades, road surfaces and the like have been equipped with coatings to stabilize the effects of industrial and vehicle exhausts.

The "Picada" research project, "Photo catalytic Innovative Coverings Applications for Depollution Assessment", examined the efficiency of photo catalytic air purifying surfaces. Results showed that it was possible to eliminate 20-80% of airborne pollutants. Thus, pedestrians walking in the vicinity of treated walls inhaled in a smaller amount of airborne impurities. It must be understood however, outdoor air purification cannot eradicate the cause of pollution but can be used to improve air quality. Thus, until a permanent solution can be found and once their effectiveness has been demonstrated, air purifying surfaces may offer a possible interim solution.

Case Study

Architect: Kazuyasu Kochi, Kochi Architect's Studio, Tokyo, Japan

Product: Moiss, air-purifying building board

Manufacturer: Mitsubishi

This uncommon weekend house is located in the countryside and although surrounded by fresh air the indoor air atmosphere remains inadequate as it is aired on an irregular basis. Through the use of unvarnished wood and air purifying building boards the architect was able to eradicate airborne contaminants and reduce the problem of poor air. As described previously the building boards break down pollutants and odours into their constituent parts. Further, the boards can be discarded in an innocuous method at the conclusion of their lifespan.



ANTI-FINGERPRINT

Steel and glass are very common materials and are more often than not utilized by architects in many interior and exterior spaces. However, as convenient and striking as they may seem, they have several disadvantages. One of these is that fingerprints show very clearly. Thus the aesthetic of hygienic appearance of the space becomes minimized when the surface is covered in fingerprints. However a solution is existent in the form of anti-fingerprint coating. Such coatings make fingerprints practically invisible on the related surface. Although they cannot be seen the fingerprints are actually there, the nano coating however makes them imperceptible by altering the refraction of the light in a similar way to the fingerprint so that fresh fingerprints have little effect. The light reflections on the coating make the surface appear smooth and thus giving it a both an aesthetic and hygienic appearance.

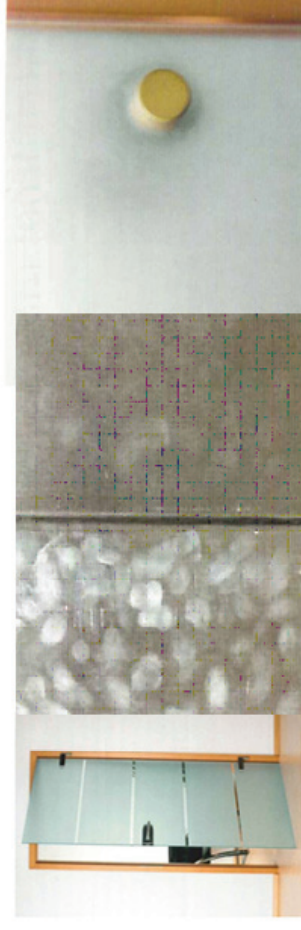
The coating does not have a great deal of influence on the characteristics of the material. It is actually ultra-thin and after steel has been coated with the nano coating it can be still bent into shape without the coating breaking or fracturing. Such a feature is very beneficial to the manufacture of specific architectural details. The coating is used mainly used on materials such as lifts, cladding and furniture.

Recently, sandblasted glass has become a widely used material in many interior spaces. Translucence has become very popular in the design of doors, partition screens and even furniture. The disadvantage is, however, that the sandblasted side of the glass is very prone to fingerprints. In many cases a silicon coating is applied to the surface and although being slightly effective it leaves a cloudy appearance when cleaned. A nano anti-fingerprint coating can make the fingerprints almost impossible to see without the disadvantages of silicon coating. These nano coatings, in turn, reduce the need for constant cleaning, saving time and money. Currently however, the coating is not completely transparent and thus has not been implemented on clear glass.

One important characteristic of the material which should be examined prior to installment is scratch resistance. The nano coating is useful for stainless steel and sandblasted glass materials that are easily susceptible to touch. Thus, nano coatings enable glass and steel to be used for both interior and exterior spaces without reducing their aesthetic and hygienic appearance.

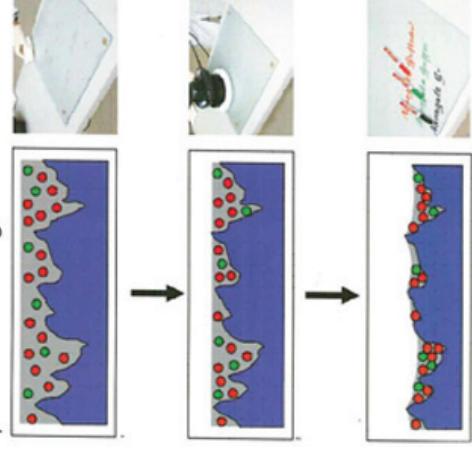
Case Study

Appropriate to critical areas around doorknobs, also allows smooth and glossy surfaces to retain their aesthetical appearance under heavy use and circulation.



The efficient principle of a coloured protective coating retrofitted to a glass surface :

- 1) The coating material is applied with a slight excess to the glass (blue). Colour pigments (red) and stabilizers (green) are controlled within the matrix of the coating (grey).
- 2) Elimination of excess material by hand or machine.
- 3) Fully hardened protective coating.



THERMAL INSULATION: AEROGEL

Nanogel, a product in the form of aerogel, has been one of the more interesting and prospective developments on the market. The product provides high performance thermal insulation as well as effective sound insulation.

Developed in 1931, aerogel has remained the lightest known solid material on the market. The Nanogel is a spherical refined material which to the human eye appears milky and translucent. Initially, aerogels were designed for outer space application.

Aerogel, however, is more ordinary than it seems. The material is better described as ultra-light aired foam that comprises of 95-99.9% air. The remaining material is made up of a glasslike material and silicon dioxide. What makes this material so important is that the air molecules which are trapped inside the tiny nanopores, each have a size of only 20nm, and are incapable of movement. This is what gives the aerogel its excellent thermal insulation properties. The very low coefficient of thermal conductivity, 0.018 W/mk, allows the material to have such a high thermal resistance. Thus, aerogels are able to help minimize both heating and cooling costs significantly. As a result, the nanogels have been used as an insulating fill material in different types of cavities such as between glass panels and acrylic glass multi-wall panels. The material is very well suited for application on the external envelopes of structures.

Further, because the material is translucent, as described previously, it has good light transmission. Hence the material is able to spread light evenly and pleasantly. By transforming direct sunlight into a glare free soft light the material terminates the need for blinds, louvers or even the need for artificial daytime lighting. As a result the material can make it seem lighter indoors than outdoors on a 'grey' day. The material does not face moisture or mould issues as a result of its hydrophobic characteristics.

In addition to its thermal insulation capabilities, aerogel also has the ability to be applied as a sound insulator. As previously mentioned, the inability of the air particles to move inside the tiny nanopores disallows sound waves from passing through the material. Consequently, nanogel filled glass panels are also suitable for use indoors in addition to their use on exterior envelopes. An example of the use of nanogel indoors may be the enclosure of conference areas in office spaces. However, for interior use the glass should be laminated in the event that aerogel filling may spill if the glass is to break.

In conclusion, it can be inferred that the primary functional property of the new material is energy efficiency. Currently only a few companies offer in this product on the international market, however, with all its advantages it seems as though it is not long before the product achieves a greater hold of the market.

Case Study

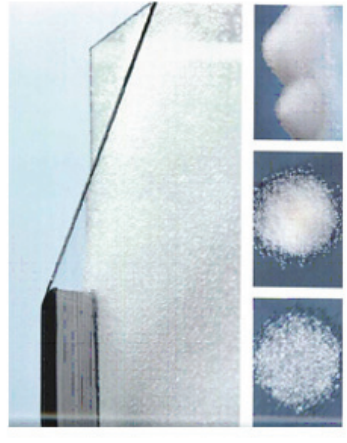
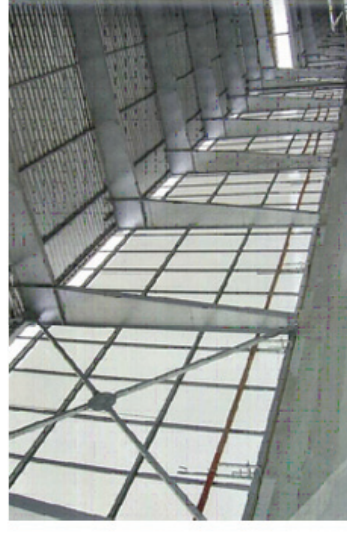
Sports Complex, Carquefou, ZAC du Souchais, France, 2006'

Architect: Agence, MA, Murail Architectures, Nantes, France

Product: Multi-wall panels with Nanogel filling

Manufacturer: Cabot Corporation

The walls of this sports complex have been constructed with aerogel-filled multi-wall polycarbonate panels. As a result the design complies with the guidelines put forward by the French "green" environment initiative. Addition indoor lighting is has been made unnecessary during the day as natural daylight provides an even flare free illumination of the indoor space with the help of the nanogel filling. The materials thermal insulating properties have also reduced the demand for heat as a 25 mm thick panel has a U-value of 0.89 W/m²K and is available in 1.05 m wide panels of up to 6 m in length.



TEMPERATURE REGULATION: PHASE CHANGE MATERIAL (PCMs)

In order to maintain a comfortable temperature within a structure requires a great amount of energy for both heating and cooling purposes. With the application of nanotechnology the energy requirement for such an objective can be significantly reduces, and in turn reducing CO@ emissions.

Phase change material (PCM) can be used to effectively regulate the temperatures inside various structures. Due to its good thermal retention qualities, PCM has the ability to even out temperature fluctuations and peaking temperatures in both new and pre-existing structures. The product can be used for both heating applications as well as cooling.

PCM's have been constantly researched over the previous century. In the early 1940's the first attempts were conducted to apply PCM within structures in the USA. However, the widespread use of PCM's did not seem feasible until the development of microcapsules. In the 1980's NASA further studied and developed PCM's and used the material to develop thermally adaptable spacesuits and gloves for astronauts allowing them to withstand extreme temperature fluctuations in outer space. However, the main application of PCM's for buildings and other structures has been energy conservation.

PCMs are made from salt hydrates and paraffin balls which, with a diameter of 2-20 nm, are enclosed in a sealed plastic casing. Because PCM's are able to absorb extreme temperatures without their core warming up, they are able to keep interior spaces cooler for longer periods by retaining the heat and using it to liquefy the paraffin. As the temperature rises within the PCM the paraffin makes a transition from solid to liquid. Similarly, when the temperature is dropping rooms are able to stay warmer for longer. Energy is stored latently when the material transforms from liquid to solid and vice versa.

Depending upon the PCM applied, to regulate a SOC temperature increase 10-40 mm of concrete is required in comparison to only 1mm PCM. Clearly, the PCM has a greater thermal capacity as the temperature of the PCM remains virtually unchanged.

Currently, PCM's have been integrating into conventional building materials such as plasters, plasterboard and aerated concrete blocks. When contact is made with other kinds of building materials, the PCM's do not cause any unwanted chemical reactions such as corrosion.

Further, due to their small size PCM's contained in various materials are practically incapable of being damaged. Thus, the material can be mechanically worked on without the fear of damaging the fear of damaging its functionality. In addition to being good energy conserves by reducing the need for heating and cooling devices, PCM's are also recyclable and biodegradable.

However, it is important to note that the paraffin which is present in the PCM's is flammable and as a result PCM products fail to be classified as flame-resistant. Also, during the phase change from one state to the other, a change in volume occurs. This must be taken into consideration when the materials are being used in tight enclosed areas.

With all their benefits PCM's have become broadly used in the constructions industry as they reduce costs and the need for air conditioning units.

Case Study

'Sur Falveng" housing for elderly people, Domat/Ems, Switzerland

Architect: Dietrich Schwarz, GlassX AG, Zurich, Switzerland

Product: Latent heat storing glass, phase change material (peM), GLASSX-crystal.

Manufacturer: GlassX



The architect has used latent heat storing glass in the disabled access flats in the Swiss Alps, where temperatures tend to be low. The central of three cavities of an 8cm thick composite glass element was integrated with a salt hydrate fill material which protects the rooms from overheating by storing heat. The heat storage has a thermal absorption capacity which is equivalent to a 15 cm thick concrete wall. The application of PCM gives the building the ability to monitor indoor temperatures and save significantly on heating and cooling costs.

TRANSPARENT ALUMINA

this nanomaterial technology has made possible the production of polycrystalline transparent ceramics such as 'transparent alumina', or 'High-strength transparent components of sub- μm Al_2O_3 ceramics'.

they are considered to be around three times more stronger than materials like steel, whilst exhibiting transparent and translucent qualities, this advanced material provides new opportunities when it comes to architectural visions, bringing to mind the idea of a complete transparent building structure and all, perhaps if disregarding its expensive price.

Advantages:

- Extremely high strength (600-850 MPa), with a high hardness and scratch resistance.
- Very high thermal performance.
- Very high chemical stability to acids, bases, and aggressive gases.
- Custom shaping possible such as complex hollow shapes.

Emerging Technology - Contact

Dr. Andreas Krell
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Phone +49 351 2553-538

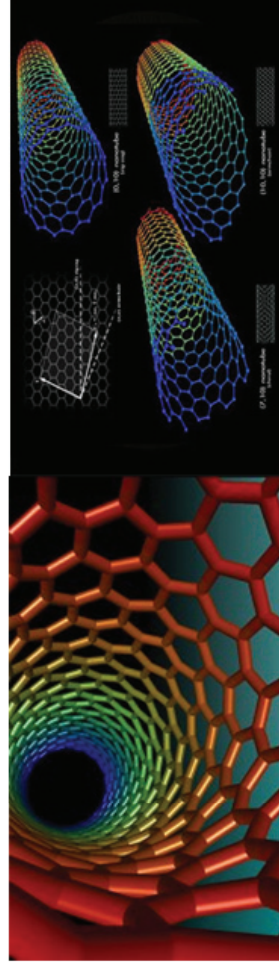
Fraunhofer Institute for Ceramic Technologies and Systems IKTS
Winterbergstr. Dresden, German



CARBON NANOTUBES

The defect free structure of these nanotubes have been predicted to result in mechanically one of the strongest material in nature. It is considered to be one hundred times stronger than steel because of its "molecular perfection".

Carbon atoms can bond with other matter; such material can be an "insulator, semi-conductor or conductor of electricity". As a result, carbon nanotubes will have a dramatic influence on the architectural industry because such materials can act as "a switchable conduit, a light source, a generator of energy and even a conveyor of matter".



The remarkable physical properties of nanotubes create a host of application possibilities:

1. Structural applications

The structural applications of carbon nanotubes are numerous due to their extraordinary strength. Such applications include waterproof and tear-resistant textiles, increased concrete strength, fire protection, increased strength in sports equipment, and synthetic muscles. The structural applications of nanotubes is a list that will continue to expand as companies innovate around the flexible molecules.

2. Electromagnetic applications

Carbon nanotubes have unique electrical properties that allow them to be used in artificial muscles, conductive films, magnets, solar cells, transistors, displays, and many more.

SUSTAINABLE MATERIALS

As the world population numbers continue to expand there has been a growing importance placed on building resources availability in the future and how this will affect future generations and the natural environment. Moreover, sustainable attributes are usually light on environmental resources and damaging impact, meaning that they are able to be reused, recycled or replenished.

Furthermore, awareness of environmental factors has increased the attention focussed on the materials industry and product life cycle, therefore sustainable materials can be defined as exhibiting the following qualities, either materials with a large quantity of plant-based ingredients, including wood, natural fibre composites and natural polymers, or materials manufactured using large amounts of waste material, such as recycled polymers, composites made from waste mineral powders, copper and aluminium.

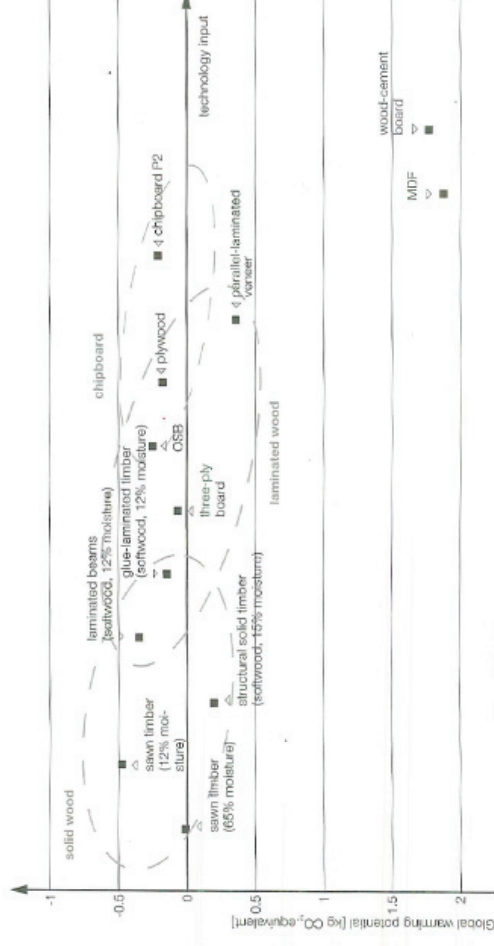
However the most sustainable and commonly used materials are wood based products. Wood is regarded as carbon neutral and environmentally friendly, as a tree grows it releases oxygen stores carbon dioxide from the atmosphere in the form of carbon. For each tonne of completely dried raw material there has been 1850kg of CO₂ extracted from the atmosphere, and stored in the wood permanently. For this reason wood as a raw material is considered as a very sustainable material, until it is processed where it becomes subjective.

The following information will provide a description on wood based materials and variations.

WOOD BASED MATERIALS

The diagram below describes the different types of wood based products and performance rating based on global warming potential left-hand/vertical bar and technology input required to produce the product on the right-hand/horizontal bar.

What can be concluded from this analysis is that the more treated and engineered the wood based material the worse it responded to an environmental improvement. However this is not all that bad as the treated materials may offer higher specification, like longer lifespan, increased strength, or require low quantity of raw materials. they may also challenge other building materials not related to wood.



Detail: Green, English Edition, Issue 02/09, November 2009

SUSTAINABLE WOOD BASED MATERIALS

This interesting table describes the different types of wood based products performance abilities which are based on the most appropriate application and its environmental assessment.

What can be concluded from this analysis is that each material has a particular advantage or speciality, however there are no price examinations.

Timber products – applications and environmental assessment					
Material/application	Columns/ beams	Load-bearing/ planting	Dry screed	Interior finish	Furniture
Solid wood board	o			o	-
Glue-laminated timber	+				
Flywood					
Veneer plywood; blockboard/panelboard		o	o	+	+
Parallel laminated veneer	-	-			
Chipboard					
Laminated flat-pressed board		+	+	o	-
Cement chipboard		o	o	o	
Oriented strand board (OSB)		+	+	o	
Fireboard					
Medium-density fibre-board (MDF)				-	-

Grey shading: suitable or approved for use; +: low environmental impact; o: average environmental impact; -: high environmental impact compared to other products.

Detail: Green, English Edition, Issue 02/09, November 2009

ENGINEERED TIMBER CASE STUDY

'Fletcher Residence, Woodend, Australia, 2005'

Engineers: TimGibney & Associates

Design: Timber Imagineering

Product: Hyspan (H3) + Hybeam (H2-S termite protected)

Manufacturer: Futurebuild

The two-storey house is 12 metres wide by 24 metres long, a modular design with portals at 6 metre centres. The portals are Hyspan Structural LVL sections and the floor joists and roof purlins are hyBEAM Engineered I-Joists, both manufactured by futurebuild. The entire structure was prefabricated in a warehouse. The timber portals were fabricated in sections and then transported to the site and assembled on the slab and lifted by crane into position. The portals were rebated to allow for hidden steel gusset plates that occur at the junctions where the timber changes directions. The base plates were fixed off to the cast in plate holding the timber to the footing. Using an engineered designed footing system the portal frame size was minimised.

Robert Nestic of Timber Imagineering explains why the futurebuild engineered building products were chosen: "We used the futurebuild LVL because of the guarantee of supply and material properties. LVL has high strength and reliability, suitable for these types of structures and is available in long lengths and in a large range of sizes." After prefabrication, the lower sections of the portals were sent for LOSP treatment, as the region is a termite prone area. The timber building system allowed the owner to complete the construction with conventional carpentry techniques. This led to the significant cost savings. Timber construction was not only possible but was a cost advantage, resulting in a timber structure Fletcher had originally imagined.

Carter, Holt, Harvey. 2005, 'Platform: Futurebuild' Issue 17: September 2005, Australia.

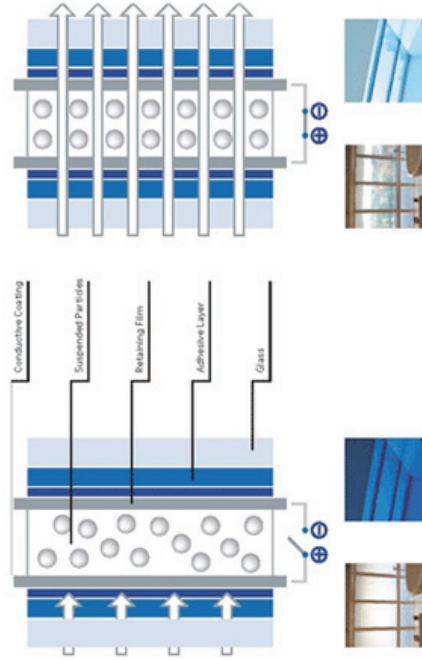
This article describes that engineered timber was selected as an innovative material to achieve a design which would have originally been achieved with steel members.

ELECTROCHROMIC GLASS

Once again innovations in nanotechnology has found a solution to an old architectural constraint, such as solar heat gain and glare affecting occupants comfort. The solar control materials like 'Infraselect' and 'SPD SmartGlass' allows the regulation of lux, glare, UV radiation, cooling and heating costs and energy transmission through the glass surfaces nano coating of tiny charged segments. The process involves attaching an electrochromic laminated film, to a glass surface, once charged ions are released in the coating, where anything up to 5 volts creates a gradual blue tinge over a twelve minute period. The pane requires an electrical control unit to allow occupants to manually adjust transmission levels.

Performance:

Energy transmittance for Double glazing 12% to 36% or Triple glazing 10% to 30%. whilst light transmittance is between 15% 50% or 14% to 45%. SPD SmartGlass can block Sizes vary between manufactures, 'Infraselect' offers 1000mm by 1000mm units and up to thirty can be connected as a system facade, with support to building system controls.



- 1) Switched on the particle molecules align, light passes through
- 2) Switched off the particle molecules are randomly oriented blocking up to 99.4% of light.

Emerging Technology - Contact

Product: Infraselect
 Manufacturer: Flachglas Markenkreis GmbH
 Phone +49 209 91329-0
www.flachglas-markenkreis.de

Product: SPD SmartGlass
 Manufacturer: SmartGlass International Ltd
 Phone: +353 (0)1 4629945 / 49



comparissons of types



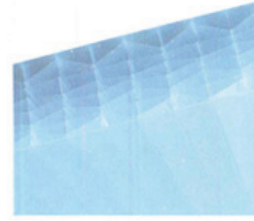
Infraselect glazing under normal conditions

Infraselect glazing with activated five Volt current, notice the strong blue tint

INNOVATIVE POLYCARBONATE PLASTICS

This interesting material offers a lightweight alternative to glazing, whilst offering many other advantages like strength to weight ratio, ability to be cut with conventional tools, good thermal properties as it traps air in segments, also shatter resistance, UV treatment and is able to be recycled at the end of its product life, usually ten years.

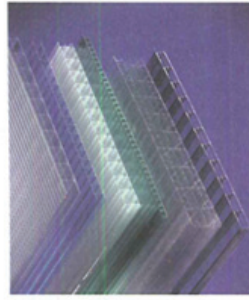
Thermal insulation



Nine-layer multi-wall sheet, Lexan Thermoclear: sectional detail.

Nine-layer multi-wall sheet

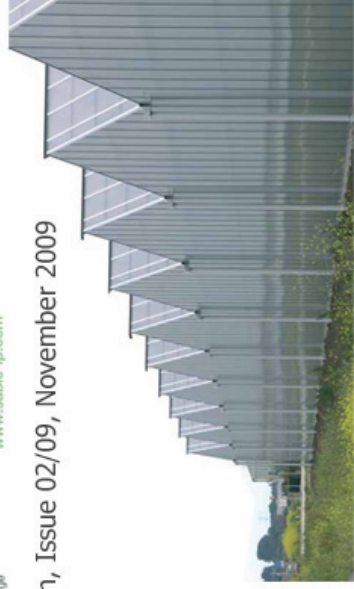
SABIC Innovative Plastics has announced it has brought out the world's first multi-wall polycarbonate sheet with a U value of under 1.0 W/m²K. This product now makes it possible to achieve improved insulation values for translucent panelling on verandas and conservatories and for roof windows and hall roofs in industry. The sheet, in the Lexan Thermoclear range, has a nine-layer X-structure. Available in 35, 45, 60 and 60 mm thicknesses, the sheets have U values ranging from 0.985 W/m²K to 1.187 W/m²K, which is significantly lower than that of argon-filled double glazing (1.4 W/m²K). The multi-wall sheets are available in opal white, solar-control green and transparent. Both sides of the sheet are treated with UV protection against outdoor weathering, and were subjected to 4,000-hour weathering tests, comparable to ten years of outdoor exposure in moderate climate conditions.



Thermoclear product range

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www.sabic-ip.com

Detail: Green, English Edition, Issue 02/09, November 2009



Case Study

'Swimming Pool Cover,s 2008'

Product: Lexan Thermoclear sheet + Lexan Thermoclear plus

Manufacturer: SABIC Innovative Plastics

"We needed a lightweight, unobtrusive and flexible material to be able to design the optimal pool cover. Following the product testing and development phase, 'SABIC Innovative Plastics' Lexan Thermoclear sheet was chosen as it exhibited outstanding formability and bonding compatibility that met all of our requirements", say Thérèse and Serge Chapus, creators of Abrisud.

The material 'Lexan Thermoclear plus' and easy clean polycarbonate multiwall sheets UV protection, provides high light transmission, very good insulation properties and impact resistance. The sheet has a coating to protect it against the effects of UV radiation. The sheet can be economically cut to in desired shape on-site with minimal waste. Moreover, the product is virtually unbreakable and is able to accommodate the subsequent temperature change to sunny conditions without breaking or buckling.

SABIC Innovative Plastics, 2008, SABIC Holding Europe BV
http://kbam.geampod.com/KBAM/Reflection/Assets/Thumbnail/7636_15.pdf
sabic-ip.com



The Polycarbonate pool covers also provide sun protection for afternoon activity

PHOTOVOLTAIC TECHNOLOGY

Photovoltaic panels is a system which can capture the sun's rays and convert to electrical energy, this version uses thin-film CIS technology named 'StoVerotec GmbH' allowing the panels to be placed on the vertical rather than the usual rooftop approach with crystalline solar cells. The innovation creates new opportunities for facade, which will now be able to capture energy.

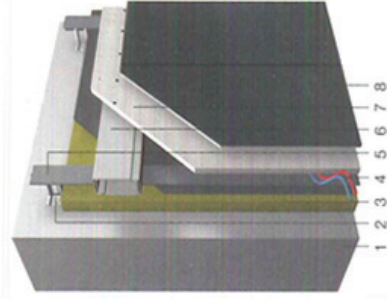
Photovoltaic on the vertical

StoVerotec, together with Würth Solar, has developed a new PV module that can be integrated in ventilated curtain walls. As with all StoVerotec's facade panels, the modules are mounted onto an aluminium frame at the back. From the outside no fixing points are evident on the panels. Mineral wool is used as insulation.

The photovoltaic modules are laminated at the factory onto a backing of recycled blown glass granulate to form a sandwich panel. Blown glass granulate has a high proportion of air sealed in pores within it, which gives a low self-weight of only 10 kg/m² for the 20 mm panel. Connection to the power supply is easy and unobtrusive, concealed in the air gap between the insulation and the panels.

The new facade panels are based on thin-film CIS technology and, unlike crystalline solar cells, different coloured versions can be supplied. But performance is affected by choice of colour: the darker the colour, the lower the performance. StoVerotec calculates that, regardless of colour, the yield from a one square-metre photovoltaic module is between 55 and 80 kWh of electricity per year.

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Layers in the facade construction.

- 1 Wall
- 2 Wall bracket
- 3 Fleece-backed insulation
- 4 Cabling
- 5 T-profile
- 6 Fixing track
- 7 20 mm backing board
- 8 CIS photovoltaic module

Case Study

'Suntech Green Energy HQ Building, Wuxi, China, 2008'

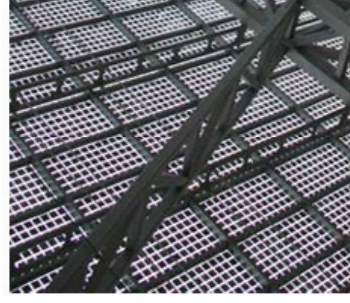
Architects: Wieser, Austria

Product: Suntech Light ThruTM Solar Glazing Panel

Manufacturer: Suntech Energy Engineering Co., Ltd.

1Mega Watt On-grid Photovoltaic Façade System, The 18,000 square meter Suntech Green Energy HQ Building incorporates one of the largest on-grid photovoltaic Façade system, using more than 2,570 'semi-transparent Light ThruTM solar panels.' the facade produces 710kW and roof 300kW creating a 1.01MW generator of energy which on average produces energy output of 730,000 kilowatt hours in one year, that's a 1,020,000 kilowatt hours saving. Supplying around 80% of total power demand for the whole building in combination with other energy-saving technologies.

Using a design similar to this means that a large amount of carbon dioxide, can be offset to balance the energy resources required to develop a new building.



separated to allow for air flow through the facade.

http://www.suntech-ower.com/products/docs/Casestudies/CaseStudy_

Detail: Green, English Edition, I:

PHOTOVOLTAIC CASE STUDY

Integrated Concentrating (IC) Dynamic Solar Facade

Continued research into photovoltaic technology has an energy generating glazing that is as capable of producing power at a more efficient rate. A system from The Center for Architecture Science and Ecology (CASE), has been developed with the intention make solar systems more atheistical, efficient and cost effective. The system consists series of pyramid-shaped glass receptors that follow the sunlight throughout the day, magnifying the incoming light and capturing it in a tiny yet powerful photovoltaic cell located in the center of each pyramid unit.

The glass pyramid shape also serve to magnify daylight to inside a building, decreasing the need for artificial light. The solution also can capture thermal energy trapped within the glass pyramids that were not converted into electricity to be used for HVAC.

This advanced solar system are not commercially available, as research is on going, however progress is being made rapidly. The estimated cost return is less than two and a half years when exposed to good daylight locations.



Liggett, Brit. 02/02/10. 'CASE Solar Power Glass Energizes Any Building Facade' viewed on 11/03/10 <<http://www.inhabitat.com/2010/02/02/gorgeous-glass-pyramid-solar-cells-energize-any-building-facade/>>

manufacturer website: <http://www.case.rpi.edu/projects/ICSolar.html>

Depending on their characteristics, their structure and other properties, materials and substances today can be generally differentiated as follows:

RECYCLABLE MATERIALS
These materials are manufactured mainly from crushed and cleaned waste. Unless the raw material is sorted in advance to separate out the valuable fractions, the resulting products are usually of lower quality than the originally used materials.
BIODEGRADABLE MATERIALS
Materials, e.g. from vegetable starches, that are decomposed and completely broken down by microorganisms living in the soil.
BIOMATERIALS
Plastics and other materials made from renewable sources. One current research focus, for example, is the use of special CO ₂ -consuming bacteria in the production of biodegradable plastics.
NONVARIABLE MATERIALS
These materials are largely unaffected by physical and chemical influences, e.g. changes in ambient temperatures. One such material is the metal alloy Invar.
FUNCTIONAL SUBSTANCES
A general term for monofunctional and multifunctional substances.
SMART MATERIALS
Belong to the functional substances. These materials, substances and products have changeable properties and are able to reversibly change their shape or colour in response to physical and/or chemical influences, e.g. light, temperature or the application of an electrical field. They can be differentiated into non-smart materials, semi-smart materials and smart materials.
HYBRID MATERIALS
These materials are manufactured by combining at least two different components, e.g. biological with synthetic components.
FUNCTIONALLY GRADIENT MATERIALS
Composite materials with gradually merging layers. This results in a continuous change in material properties.
NANOMATERIALS
Materials made from nanometre-scale substances. They can be used as coatings or in product manufacture, for example.

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